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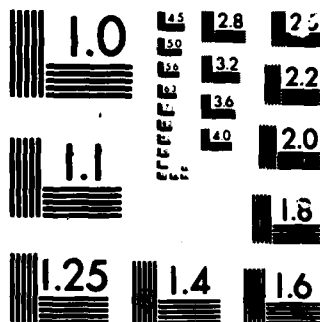
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## SUPERLATTICE OPTICAL BISTABILITY RESEARCH

## QUARTERLY TECHNICAL REPORT

1 July 1985 through 30 September 1985

AIRFORCE OFFICE OF SCIENTIFIC RESEARCH

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19 ABSTRACT (Continue on reverse if necessary and identify by block number)  This report summarizes our progress and results during this reporting period. Complete automation of the MBE system shutters was achieved and a number of superlattice samples of HgTe-CdTe were grown. Most of these samples, however, show polycrystallinity. Deposition parameters need to be optimized for better quality samples.				
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## PROGRAM PROGRESS

During this reporting period the automation of MBE system shutters was completed for the substrate and the Hg, CdTe, and Te sources. As reported earlier, the automated shutter operations allow for much more precise thickness control of the superlattice layers during the deposition. Also, from signal-to-noise considerations, performing the nonlinear optical experiments requires the use of thick ( $> 2 \mu\text{m}$ ) superlattice samples which involve several hundred layers of HgTe and CdTe. This can best be accomplished by using an automated MBE system. The current superlattice design calls for alternate layers of HgTe and CdTe with thicknesses of 100-150 Å. A p-type sample with this structure is expected to yield a third order susceptibility ( $\chi^{(3)}$ ) of 100 times larger than that of the bulk HgCdTe.

A number of test runs were carried out with the automated MBE system. These runs resulted in five superlattice samples of various thicknesses. Characteristics of these samples are shown in Table 1. Sample #4 is now being used in a preliminary experiment of optical phase conjugation to establish baseline data.

TABLE 1 CHARACTERISTICS OF HgCdTe FABRICATED SUPERLATTICES

SAMPLE #	# of PERIODS	TOTAL THICKNESS ( $\mu\text{m}$ )	THICKNESS OF HgTe	THICKNESS OF CdTe	CRYSTALLINITY
1	100	~8	~400 Å	~400 Å	Poor
2	100	~8	~424 Å	~424 Å	Polycrystalline
3	100	~2.4	~155 Å	~80 Å	Polycrystalline
4	70	~2.6	~300 Å	~100 Å	Crystalline
5	70	~2.6	~300 Å	~100 Å	Poor

These samples were less crystalline than the thinner samples that were previously made via manual control. The deposition parameters still require further optimization. The key parameters are associated with the deposition of the HgTe layer which have very tight tolerances for achieving crystallinity and stoichiometry. We are still in the early part of the learning curve for fabricating consistent, good quality superlattices.

## FUTURE PLAN

Since the key issue is obtaining highly crystalline and stoichiometric superlattices, we will concentrate on fine tuning the deposition parameters of the constituent layers. Very thin ( $\sim 100\text{\AA}$ ) layers of HgTe and CdTe will be analyzed respectively via in-situ RHEED as a function of deposition parameters (substrate temperature, Hg flux, deposition rates, etc) which would allow epitaxial deposition of the individual layers. From these results, an operable set of parameters will be used for the final deposition of HgTe-CdTe superlattices. The calibration runs are being conducted and the deposition of superlattices is scheduled in October.

After achieving the growth and fabrication of satisfactory superlattice samples which meet the thickness, layer integrity, and the overall quality requirements we will perform an optical phase conjugation (four-wave mixing) experiment to measure the superlattice's third order susceptibility ( $\chi^{(3)}$ ) and compare it to that of the bulk HgCdTe. We will then perform a pulsed optical bistability experiment to measure the switching time as well as the critical intensity for the transition between the two bistable states.

## FINANCIAL

As of September 22, 1985, \$93869 through price has been spent.

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